

1630-29

Enjoy **B**etter Living

with Radiant Sunny Warmth





# First of all, what are the essentials of

## Good Heating

The object of this book is to explain in simple, non-technical language some of the basic principles of good heating and to tell you about some of the marvelous advances that have been made by the heating industry in recent years to bring you close control of temperature, day and night, with the utmost fuel economy.

Let's decide first of all what constitutes good heating. Certainly the first essential of good heating is that it should be central heating. You want your entire house heated from one central source and the heat properly distributed.

A good heating system should warm the home without the discomfort of drafts. In a properly heated home there is no rapid air movement to create discomfort.

It should be clean. It should be durable with low repair and maintenance costs. You don't want a heating plant that will need replacement in whole or in part in a few years. It should be economical to operate. It should be safe, without the possibility of combustion gases permeating the house or creating a fire hazard.

It should have flexibility so that it will heat adequately in severe weather but not overheat in mild weather. It should distribute heat near the floor where it is felt—at ankle height. Differences in temperatures between floor and ceiling should be small. The heat distribution should be such that occupants will be comfortable at any place in the room even near outside walls and at windows.

Above all it should provide sun-like radiant warmth. This and the other foregoing essentials will be discussed in detail in the following pages.



*Draftless*



*Durable*



*Economical*



*Flexible*



*Radiant*



# Careful Selection of

**T**HROUGHOUT your entire home, no other single item of equipment will so greatly affect your 'round-the-clock comfort as your heating system. The time and thought given to its proper selection will pay future dividends in dollars, health, and happiness.

Even though your house is tastefully furnished and decorated, neither your family nor your guests will get much pleasure out of it if the rooms are chilly, or if drafts endanger comfort and health. Entertaining friends, listening to the radio, playing games, reading . . . they're all part of the pleasures of home only when it is comfortably warm. Good heating lets you enjoy the real spirit of true family life.

As indicated by the illustration at the bottom of this page, some degree of warmth is required during eight months of the year in most parts of the country. Thus, for two-thirds of the year, your family will be dependent on the heating system for warmth and comfort. This is another reason why you should select your heating system with great care.

An adequate heating system ordinarily represents from 6 to 10 per cent of the cost of your home. It is a basic factor in establishing the resale or rental value of any building. An investment in good heating when you are building or modernizing pays cash dividends for many years in lower heating costs, lower upkeep, and better health.

And good heating doesn't mean expensive heating—but it does mean an adequate heating system, properly sized, properly installed, and properly controlled.

Often the difference in original cost between an efficient

and economical heating system and an inferior system amounts to only a small percentage when considered in relation to the total value of the house.

There is one other very important point that should not be overlooked. In selecting heating equipment for a new house or for the modernization of an old house, the architect, the builder and owner should remember that there are three costs—original cost, cost of operation (such as fuel) and cost of upkeep to be considered. The cheapest heating system from the standpoint of original first cost may be the most expensive to operate.

People in the heating business know this. They invariably will advise careful consideration of the probable life of the heating system, and the reputation of the heating system for fuel economy—or lack of economy.

Let's be specific. The source of heat for hot water and steam heating systems is a boiler. Every heating boiler is water-backed. This means that water circulates in back of all the surfaces that are exposed to the heat of the fire. The water backing of boilers prevents the flames and hot gases of combustion from distorting and destroying the heat-absorbing surfaces of the boiler. Cast iron boilers are highly resistant to rust and corrosion. With proper care, many cast iron boilers have given more than half a century of service.

Therefore, be sure that the system and equipment you select for your home have been thoroughly tested by extensive service under actual operating conditions. When you select cast iron heating equipment you have the right to expect many years of dependable service.



# Your Heating System is only Common Sense



*Every housewife knows how quickly a pan is ruined if left without water on a hot stove. This can't happen to a steam or hot water boiler, because all of the surfaces exposed to fire have a water backing which continuously carries away the heat as fast as it is generated.*



*The owner of a hot water or steam heating system is not continually paying for replacements and repairs.*

**NEEDED IN YOUR HOME 60% OF THE YEAR**



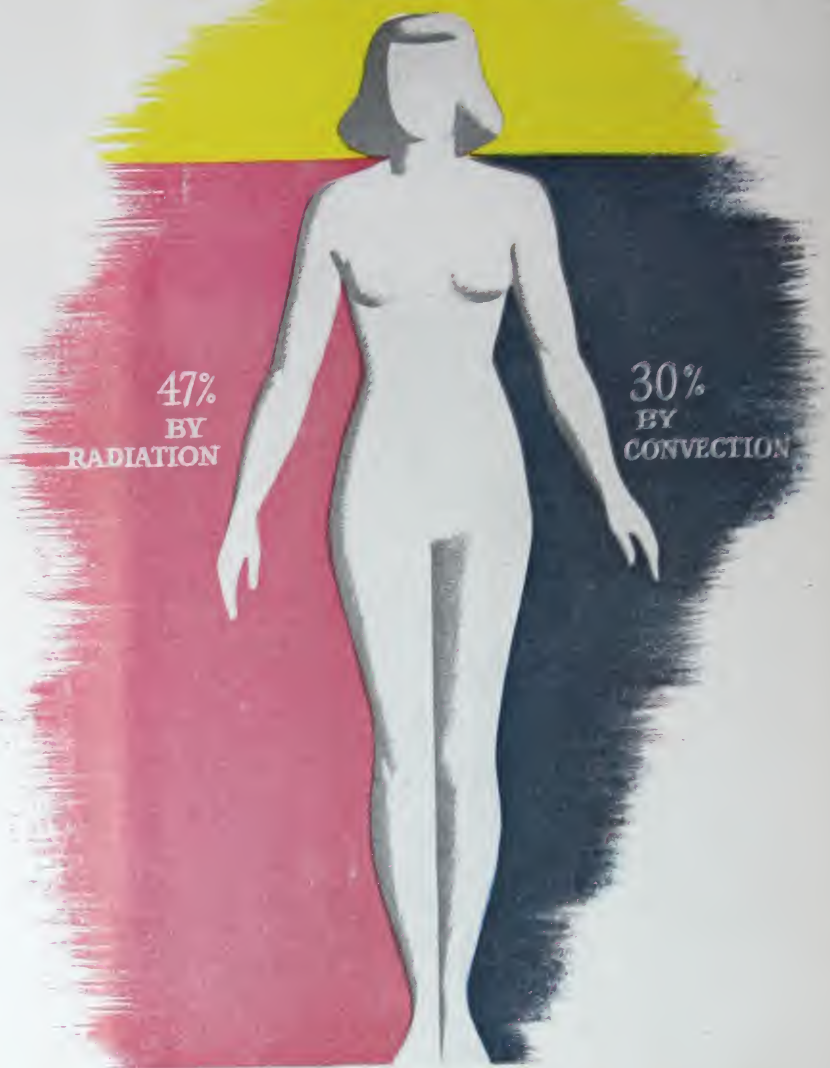
23% BY EVAPORATION

what is

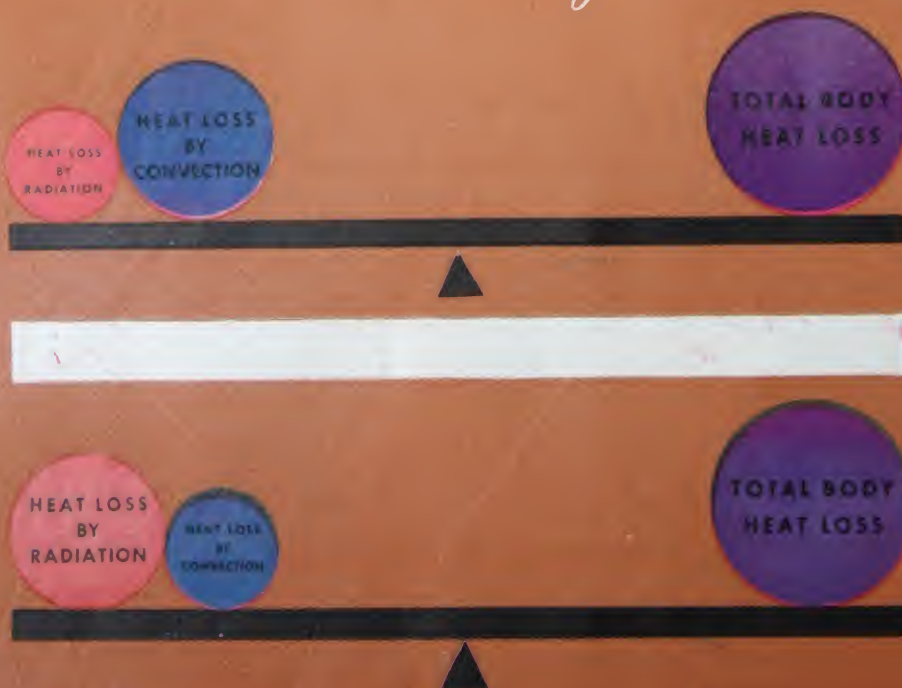
# Comfort?

You can make a more intelligent and satisfactory selection of a heating system if you are familiar with the conditions which create maximum comfort. On the following pages is a discussion of the elements which scientific investigation has shown to be the governing factors in establishing the best in heating.

*The percentages shown in the illustration above indicate the amounts of heat loss of various kinds from the body under normal conditions for normally clothed average human beings seated and at rest. These percentages are taken from Chapter 31, Heating, Ventilating, Airconditioning Guide, 1946.*



## The Comfort Balance



These two diagrams illustrate the fact that the human body can be comfortable even though the relative percentages of body heat loss by Radiation and Convection vary in some degree. The sum of the two, however, must equal the total normal heat loss by Radiation and Convection.

Since the amount of body heat lost by Radiation and Convection constitutes the greatest portion, the heat loss by Evaporation is ignored in this illustration.

**I**N the first place, it must be understood that physical comfort is not a matter of supplying heat to the body—*your body manufactures its own heat!* Comfort actually depends upon the rate and manner in which heat escapes from the body. If it escapes too rapidly you feel chilly, if too slowly you are hot.

The function of a heating system is to set up conditions under which the heat escape from the body can be controlled to provide the greatest sense of comfort. It is logical to assume that the system which establishes the most favorable conditions, is the one you want for your home.

For healthful comfort, body heat should be dissipated at the same rate at which it is generated. It should be emphasized here that the *manner* in which it is lost may be equally as important. This may be the factor which determines the degree of comfort you enjoy.

As shown by the figure on the opposite page, excess heat is lost from the body in three principal ways—by Radiation—by Convection—and by Evaporation. The Radiation loss is the heat transmitted from the warm body to surrounding cooler surfaces. The Convection loss is the heat carried away by the passage of air over the skin and clothing, and the Evaporation loss is largely heat used up in converting moisture on the surface of the body into vapor.

Extensive laboratory experiments indicate that in a room with 70° air temperature, genuine comfort is attained when heat losses of the body occur in approximately the following percentages: by Radiation 47%, by Convection 30%, and by Evaporation 23%. It will be shown a little later, however, that within certain limits, these percentages can be varied without sacrificing comfort.

Since the amount of heat lost by Radiation and Convection constitutes the greatest portion, the problem of providing comfort is principally concerned with establishing the proper relationship between the two.

### *The Comfort Balance*

Your body has considerable flexibility in adjusting itself

to varying temperature conditions. If, for example, the air becomes cooler, the amount of heat given off by Convection *increases*. This should cause a sensation of chilliness, but you will remain comfortably warm if the amount of heat given off by Radiation is proportionately *decreased*.

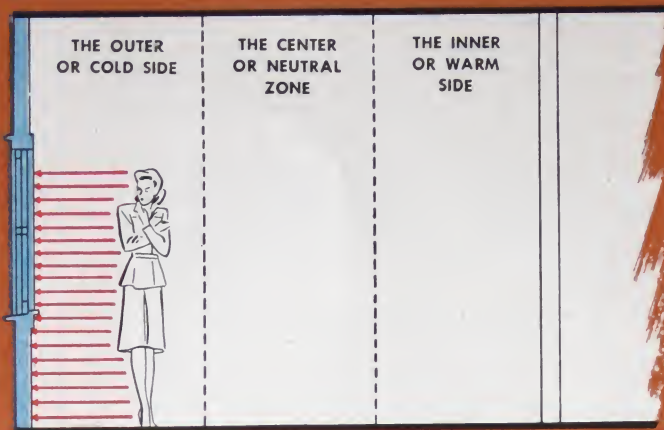
Therefore, you can be comfortable if your excess heat is given off by either Convection to the air or by Radiation to the surfaces surrounding it, provided that as one kind of loss increases, the other kind decreases. This can be called the "Comfort Balance."

Bear in mind, though, that the above statement is true only within certain limits. For example, tests have shown that in a room with cold walls, a sensation of chilliness is experienced even though the air temperature is over 70°. A well known heating authority has said that only by raising the temperature of the air or of the cold wall surfaces can the chilly sensation be overcome. If the walls remain cold, the compensation effected by raising the air temperature may still be incomplete. The relative heat losses may be in balance, but the Radiation loss from the warm body to the cold walls may so greatly exceed the ideal percentage that the heating no longer provides true comfort conditions. *In other words, maximum comfort cannot be attained if radiant heat losses are non-uniform or too large.*

Conversely, there is plenty of evidence to show that comfort conditions can be maintained by restricting almost completely the Radiant heat loss of the body. An excellent demonstration of this fact is shown in the photograph below. Here, at Sun Valley, bathers are perfectly comfortable in air temperatures below the freezing point. The cold air greatly increases the Convection heat loss, but Radiant Heat Rays from the sun, striking on the bathers directly and by reflection from the snow, cause such a decrease in the Radiant heat loss that perfect comfort results.

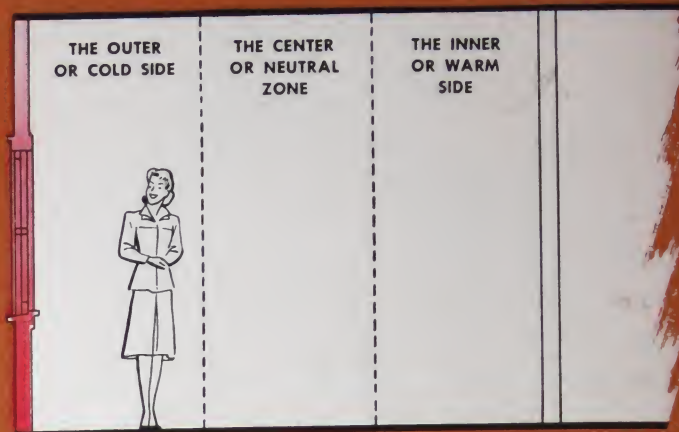
*This condition is rather extreme, but it seems logical to say that a heating system which furnishes a proper proportion of Radiant Heat with minimum air temperatures will best establish the conditions required for maximum comfort.*





#### INCORRECT

This illustration shows the incorrect heating resulting when no source of heat is provided along an outer wall. The portion of the room adjacent to the cold exposed wall is uncomfortably cool. Because of the excessive radiant heat loss from your body to the cold wall, you are literally heating the wall!



#### CORRECT

With the source of heat placed along the exposed outer wall, an effective barrier is interposed against incoming cold. Instead of drawing heat from the bodies of room occupants, the wall becomes sufficiently warm to keep the radiant heat loss within the comfort range. Hence there are no Cold Zones—all portions of the room are livable.



# adiant Heating

What is Radiant Heat, that it should have so strong a bearing on our comfort? What are its characteristics?

Any heated object gives off Radiant Heat Rays . . . the earth itself is warmed by Radiant Rays from the sun. These Rays travel through the air without appreciably raising its temperature, but warm every *solid* object they meet. In behavior they are very much like light rays, because they travel in straight lines and are absorbed and reflected in varying degrees by the surfaces they strike against.

Radiant Rays move from warmer to cooler objects. When they strike a cooler surface, a portion of them is absorbed and the balance reflected. The absorbed rays warm the surface, which then re-radiates its own rays.

The movement, absorption and reflection characteristics of Radiant Rays are the qualities upon which Radiant Heating is based.

## *How Radiant Rays Are Used to Heat the Home*

With any kind of heating system, all room surfaces must be warmed before comfort can be attained. Therefore, an important function of a heating system is to raise the temperature of room surfaces until the radiant heat loss of the body does not exceed the comfort limit.

The modern and effective way of accomplishing this is by the use of Radiant Heat in any of its many forms, as described

later in this booklet. Radiant Rays travel from their source to all surrounding surfaces, warming the floors, walls and ceilings quickly and evenly. Radiant heat loss from the body is thus kept within the range prescribed by true comfort conditions.

In radiant heating systems, Radiant Heat Rays have their origin in hot water or steam, which circulates from the boiler to radiators, radiant baseboards, convectors or concealed pipe panels. The comforting warmth you feel from these radiant rays is supplemented by warm air rising from the heating units.

## *A Radiant Heating System Distributes Heat Correctly*

Radiant Heating units can be placed where common sense tells us that most heat is needed. Under the windows, for example, where they meet and counteract the stream of cold air which pours down the panes and leaks in around the sash. They can be placed along the outer or colder sides of a room, because it is to these surfaces that the greatest transfer of radiant heat from the body occurs. They add warmth to the floors because of the travel and penetration characteristics of Radiant Rays. As visualized by the illustrations above, radiant heat makes all portions of a room livable.

To sum up, the outstanding advantages of hot water and steam heating systems, whether by radiators, radiant baseboards, convectors, or pipe panels, can be described as follows:

In the radiant heated home, the walls, floors and ceilings are quickly warmed by the absorption of radiant rays from the source of heat, whether radiators, radiant baseboards, or concealed pipe panels. These warm surfaces then re-radiate their own rays and restrict the radiant heat loss of room occupants so that ideal comfort conditions are achieved.



## best fulfills Comfort Requirements

1. The straight line movement of Radiant Heat Rays warms all surfaces of the room without creating drafts and without the need for high air temperatures.
2. There are no cold areas at the windows and along outer walls—all sections of the room are made comfortable by the correct placement of heating units.
3. When the source of heat is shut off, there is a gradual slow-down in the transmitted heat, rather than an abrupt stoppage.
4. Temperature differences from floor to ceiling are slight—no hot heads and cold feet.
5. Radiant heat is clean heat.
6. In the radiant heated home, rooms exposed to germs or bacteria (sick rooms) may be closed off so that infection is not spread by the heating system.



*The effect of radiant rays is demonstrated on a day when the sun is bright but the air cool. When standing in the sunshine, you are comfortably warm—moving into the shade causes a sensation of chilliness. You have been cut off from the sun's radiant rays and immediately notice a change in comfort sensation.*



*Radiant Rays always move from warm to cooler surfaces.*



*A portion of the Radiant Rays are absorbed by the cooler surfaces, thereby warming them.*



*The balance of the Rays are reflected to other surrounding cooler surfaces.*

# You can have Radiant Heating

**R**ADIANT heating is flexible. You can have it with any type of fuel—gas, oil, or coal, fired either manually or automatically.

Heart of the radiant heating system is the boiler. Here is where fuel is turned into heat. Here is where efficiency counts most.

In considering the purchase of a boiler, the most important point to check is its capacity. Make sure that the boiler doesn't fall short of your maximum requirements, yet won't waste fuel by exceeding them. Insist upon having guaranteed capacity ratings. Recognized ratings of cast iron boilers are known as I=B=R Ratings. The initials stand for The Institute of Boiler and Radiator Manufacturers. The adoption in 1939 of the I=B=R Code for the testing and rating of cast iron boilers provided, for the first time, a uniform and scientific method of determining boiler output and establishing dependable boiler ratings.

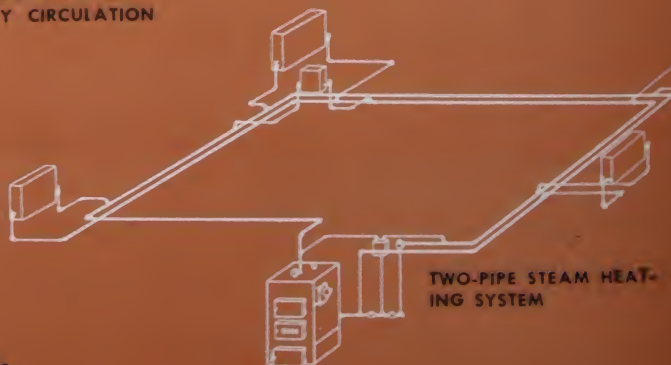
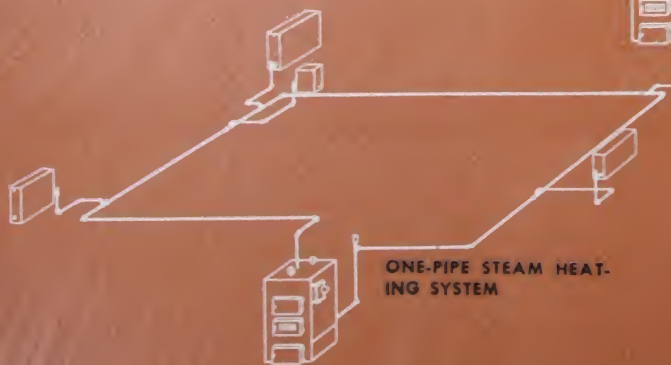
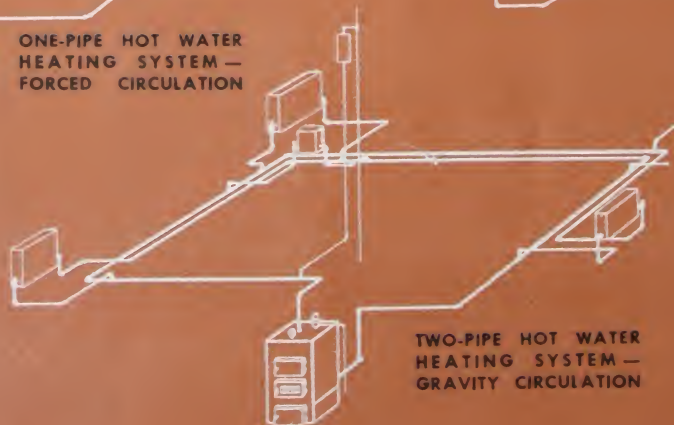
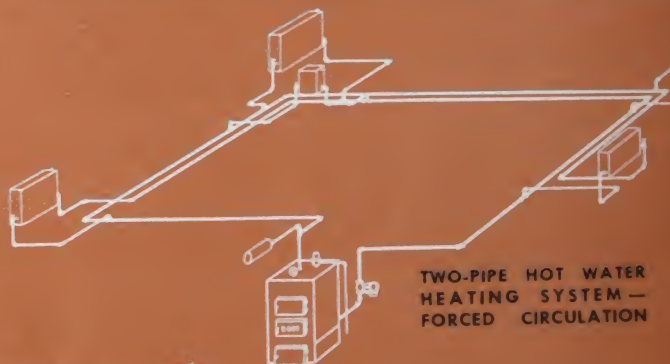
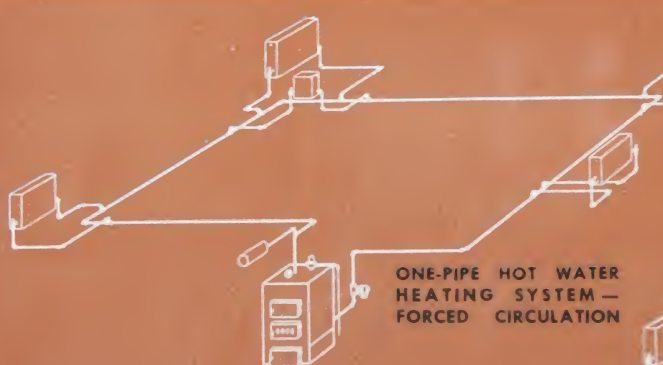
Other important features of the boiler are efficiency,

dependability, and smartness of appearance. For you want to be sure that the boiler you choose will continue to be a sound investment for many years after you have had it installed.

While boilers may be classified in various ways, the most important groups from the standpoint of the home owner are those designed for a particular fuel and those in which any fuel can be used.

There are gas-design boilers; oil-design boilers; and conversion or all-fuel boilers. Under the impetus of the I=B=R testing and rating program, many boilers have been re-designed for compactness and efficiency.

With so many types of heating systems from which to choose, you might wonder just which one is the best for you. Discuss this with your heating contractor. He will be able to advise you regarding the type of fuel—coal, oil, or gas—and the type of system which will best suit your particular requirements.



# with any of these Systems



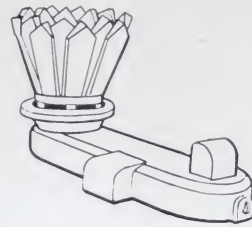
GAS-FIRED BOILER



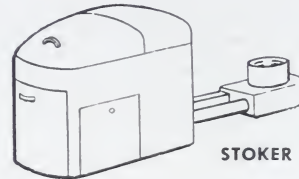
HAND-FIRED BOILER



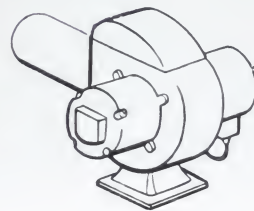
OIL-FIRED BOILER



GAS BURNER



STOKER



OIL BURNER

MANY BOILERS CAN BE CONVERTED FROM ONE FUEL TO ANOTHER.

## *Forced Hot Water*

Forced Hot Water Systems are divided into two types known as "intermittent" and "continuous" circulation systems. Both are well adapted to indirect heating of domestic water, summer and winter (see pages 12 and 13).

In the intermittent type, the water is circulated to the radiating surfaces by a small, inexpensively operated electric Pump. When the room Thermostat calls for heat, the Pump and Burner start simultaneously. The Pump rapidly circulates heated water through the system until the heat requirement is satisfied, whereupon both Burner and Pump are stopped by the Thermostat.

A Control Valve in the supply main supplies the final touch to accurate heat control. Whenever the Pump is not running, the Valve automatically closes tightly, shutting off gravity circulation and preventing delivery of unwanted heat.

In the continuous circulation type of system, the Pump runs continuously. Hot water from the boiler is admitted into the circulating stream through a special valve in just the amounts necessary to offset the building heat loss. This type of system can be controlled either by a room thermostat or by an "outdoor" type of control which is actuated by outdoor temperatures.

## *Gravity Hot Water*

This system is moderate in cost and will function with either manual or automatic firing. In contrast to forced circulation systems, the operation of gravity hot water depends upon the difference in weight between hot and cold water. The difference in weight causes a constant movement

through the system of heated water flowing upward from the boiler and cooled water flowing downward back to the boiler from the radiating surfaces.

A principal advantage of this system is the simplicity and minimum of mechanical devices required for its control. Indirect heating of domestic water is not recommended with gravity hot water because a large part of the time boiler water temperatures are too low.

## *Steam and Vapor*

Steam heating systems are divided into two classifications, one-pipe and two-pipe. These systems are well adapted to indirect heating of domestic hot water, winter and summer.

One-pipe steam is the simplest system which makes possible the comfort of radiant heating. The system is inexpensive to install because only one pipe is needed to circulate the steam and return the water of condensation to the boiler. It can be either manually or automatically fired. Depending upon the type of firing, the radiators can be equipped with vacuum valves which permit operation on low steam pressure or vacuum.

In a two-pipe system, low pressure steam or vapor is circulated to the radiating surfaces through one set of pipes and the condensate returned to the boiler through another set. Since the system is equipped with a special vacuum valve which exhausts air and prevents its return, it operates part of the time under a partial vacuum and part under very low steam pressure, which reduces fuel consumption.

A further advantage of a two-pipe vapor system is that room-by-room control of temperature is possible by merely varying the openings of the graduated supply valves installed on the radiators.



## ou have a choice of these methods

### *Radiators*

Slender perfection is the fashion for today's free-standing radiator. These pictures indicate the streamlined beauty of the modern radiator, which may be free-standing as shown above or recessed as illustrated at the lower left. Particularly gratifying from the point of view of homemakers and decorators is the fact that these radiators are so small and good-looking they blend inconspicuously and harmoniously with the finest furnishings. Moreover, in spite of their smaller size—40 per cent smaller than their predecessors—these radiators give off just as much heat. Radiators provide radiant warmth; they should be placed under windows to meet the cold air as it enters.

One of the advantages of radiator systems is that when the thermostat shuts off the heat supply, the radiators do not cool immediately. Therefore, there is a constant source of heat in

the room which compensates for the continual heat loss. This tends to prevent the possible chilling effect which might take place if the entire source of heat were cut off at once.

The handsome heating unit shown in the illustration at the lower right is one of the notable advances in heat distribution, known as the radiant front radiator. As the name indicates, the unit has a live or radiating front. Radiant front units are well suited for recessing, wholly or partially, in the wall under windows.

The unit shown in the illustration has a grille at the top for the release of convected heat. Air from the floor is drawn in at the bottom of the unit, passes over the convector behind the front, and then emerges through the grille. The secret of heating comfort is a room where walls and furnishings are warm and the air is not overheated.

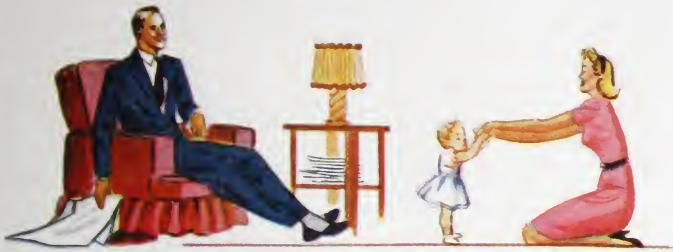
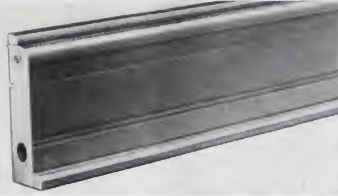


## Radiant Baseboards

Picture your home with uniform, healthful warmth coming from a source of heat so inconspicuous as to be practically invisible! This is one of the benefits of the new radiant baseboards which provide healthful radiant heat at ankle height. The radiant baseboard—a hollow cast-iron unit approximately the same size and appearance as the conventional wooden baseboard—replaces the wooden baseboard on one or more of the outside walls.

Tests of the radiant baseboard in the I=B=R Research Home have disclosed that the floor-to-ceiling temperature differences are the smallest ever achieved by the University in tests of any type of heating unit. Even in sub-zero weather, the floor-to-ceiling differential is less than 3 degrees!

Radiant baseboards are practical, easy to install, reasonable in price. They can be used with any hot water, two-pipe steam, or vacuum system, both in new homes and other types of buildings, and for modernization work.

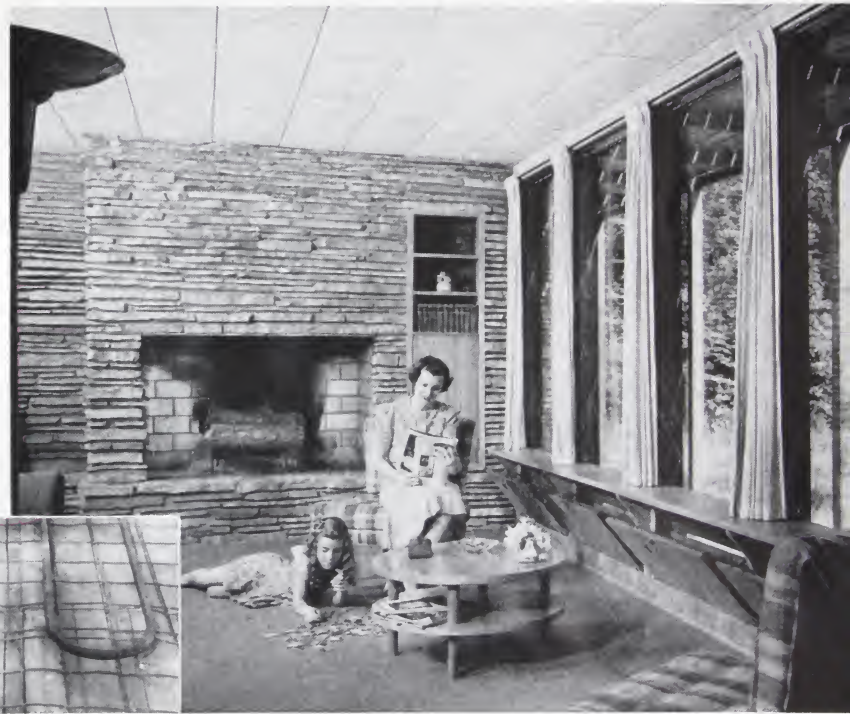
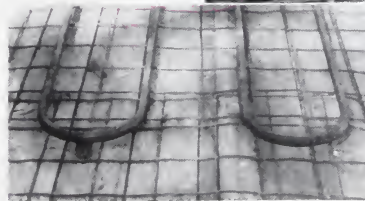


# of Heat Distribution

## Radiant Panels

Another indication of flexibility of radiant heating is the fact that pipe coils in walls, floors or ceilings may be heated by low temperature hot water and thus become radiant surfaces. This method of heating has aroused considerable interest in recent years, particularly in industrial buildings. This type of installation should be laid out by a qualified engineer or heating contractor because, once installed, changes cannot readily be made.

The radiant heat rays from the panels warm the room and objects in it either directly or by reflection and re-radiation from one surface to another. The warm floors and draftless condition in radiant heated homes contribute materially to comfortable, healthful living.



## Convectors

Smooth, streamlined, and unobtrusive is the convector, a room heating unit which fits in with modern decoration.

Convectors are made with a removable front, having an arched opening at the bottom and a grille at the top. Air enters the convector through the arched opening near the floor and is heated as it passes through the heating unit. Before entering the room through the upper grille, the warmed air heats the enclosure front, converting it to a radiant heating panel.

The front panel may be painted to match any decorative treatment, or the convector may be installed in the wall, allowing the panel to be painted or papered exactly like the rest of the room. While convectors lend themselves readily to complete recessing in the wall, they may be free-standing or partially recessed.





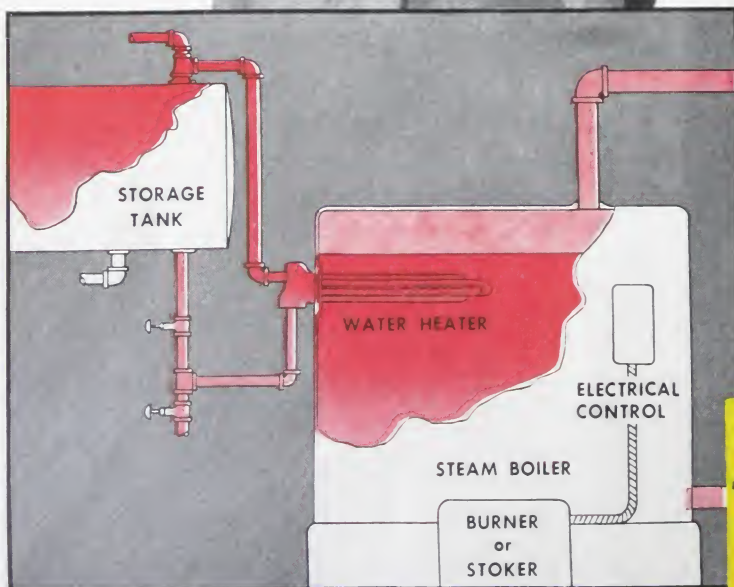
## Year 'round Hot

Hot water, plenty of it, at all times, makes all household tasks easier—makes for cleaner, healthier living.

New equipment for the modern home, such as electric dishwashers and automatic washing machines calls for even larger quantities of hot water. Indirect water heaters in connection with automatically fired hot water and steam heating systems are fully able to meet the growing demand for hot water in American homes. The same boiler which supplies heat for the home also heats the domestic water, thus saving space and the cost of extra equipment.

Tests conducted as part of the I=B=R Research Program at the University of Illinois have shown that this is a very

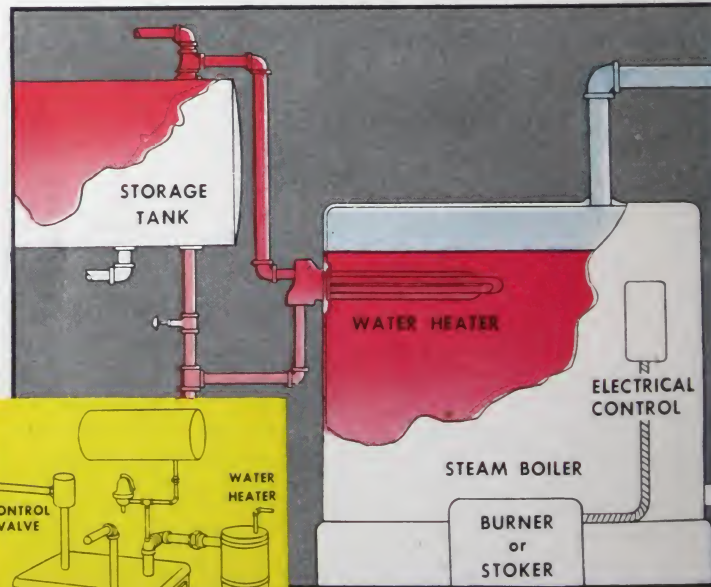
**\*BUILT-IN HEATER AND STORAGE TANK ON STEAM BOILER**



**Winter operation**

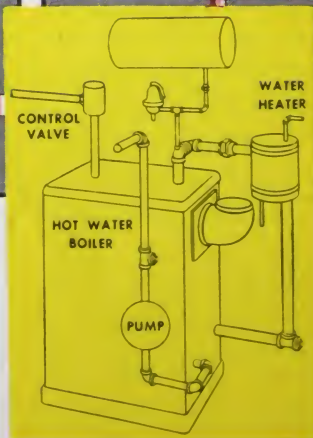
Here the boiler is producing steam for heating the home and also indirectly heating the domestic hot water. The domestic water is heated by the boiler water circulating around the coils of the heater.

\*As illustrated at right, Indirect Water Heaters, in either tankless or storage tank types are also available for external application to the boiler, instead of being built-in.



**Summer operation**

In summer, the Electrical Control is set to keep the boiler water below the steaming point. Hence, no heat rises to the radiators, but the boiler water is hot enough to heat the domestic water flowing through the coils of the heater. Fuel consumption is amazingly low.





# Water heated by the same boiler that heats the home

economical way to heat water. The University found that the annual cost of heating domestic hot water drawn at the rate of 50 gallons daily, with oil at 8 cents per gallon, is \$20.40 per year or \$1.70 a month.

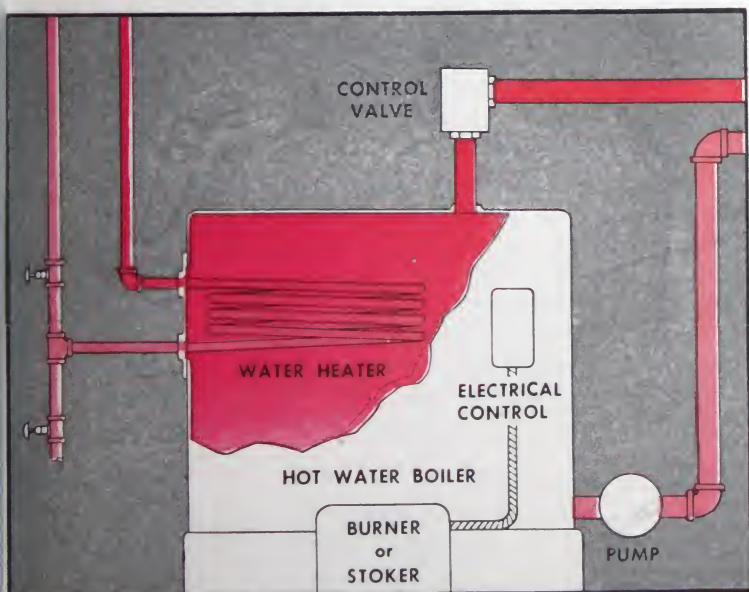
There are two types of indirect water heaters. The *storage* type heats water which is stored in a tank for use as needed during the day. All that is required are the copper coils, built into or connected to the heating boiler and immersed in the hot boiler water, a storage tank and the piping between the storage tank and heater. The domestic water, as it is heated, circulates between the heater and the storage tank.

The *tankless* type works on exactly the same principle as the storage type. However, it has many more feet of copper coils than the storage type. The resulting longer travel of the domestic service water through this extra length of copper tubing enables it to be heated instantaneously as it is used in the home.

*Boiler water and domestic water are in separate circuits and never mix.*

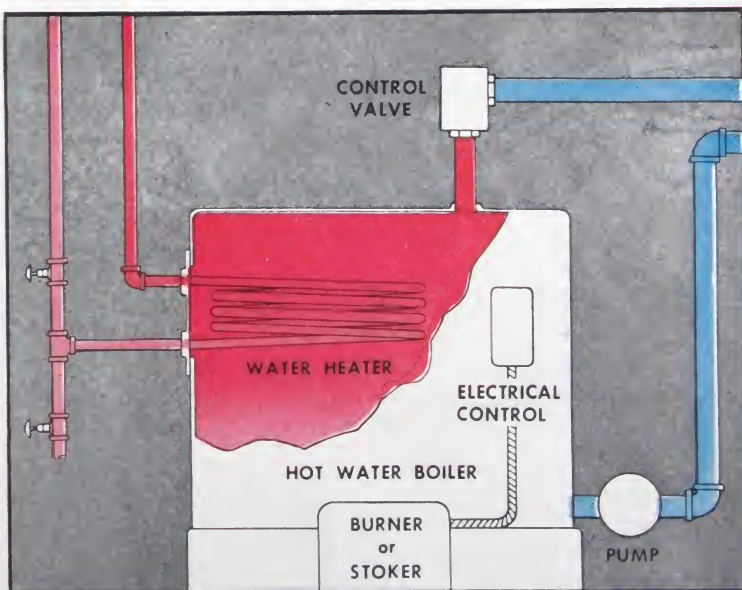
It is, of course, possible to heat domestic water with a separate water heater.

\*BUILT-IN TANKLESS HEATER ON HOT WATER BOILER



Winter operation

*In winter, the Circulating Pump of a forced hot water system operates just often enough to satisfy the thermostat. When the Pump is running, the Control Valve is forced open, permitting hot boiler water to flow through the heating system. At all times, hot boiler water circulates around the Water Heater, thus heating the domestic water.*



Summer operation

*During the summer, the boiler water is maintained constantly by the Electric Control at a temperature high enough to heat domestic water. The Pump, however, does not run unless room temperature should drop below the thermostat setting. Therefore, the Control Valve remains tightly closed, preventing circulation of hot water through the heating system. Hot boiler water, however, at all times circulates around the heater coils, heating the domestic water at very low cost.*



## Precise Regulation of temperature

Controls are the "brains" of the heating system. Controls are indispensable for automatic heating, for safety, and for the precise regulation of temperature on which perfect comfort depends.

Remarkable improvements have been made in recent years in controls, particularly with respect to greater sensitivity, zoning, and modulation of the heat supply.

Controls are "teamed up" with hot water and steam systems to provide new high standards of comfort, healthfulness, economy, and efficiency. It is of interest to note, in this connection, that hot water and steam are especially susceptible to close control of temperature and thus in the best position to provide the utmost in comfort.

Zoning enables the occupants of a building to have various selected temperatures in different parts of the building at the same time. Zoning is a simple matter with an automatically-fired hot water or steam heating system.

Modulation is the term applied to the adjustment or regulation of the temperature of a continuously flowing heating medium. Thus there is a constant flow at a rate and temperature which will exactly compensate for the heat loss of the building. In the case of a hot water heating system, the water is delivered continuously to the radiating surfaces at varying temperatures ranging from the very hot to the barely warm. The boiler is at a steady temperature providing a constant reservoir of heat.

*Modern temperature controls have the house snugly warm at any hour desired. No shivering shavings and comfortless breakfasts.*



*No matter if the weather is merely raw and chilly or below zero, a properly controlled Radiant Heating System keeps indoor temperature at 70 degrees or whatever temperature is desired.*





# achieved by Modern Controls

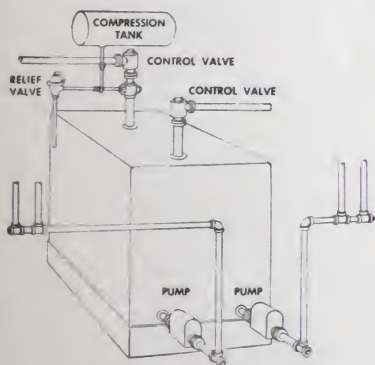
## ZONING OFFERS THE ULTIMATE IN TEMPERATURE CONTROL

Zoning provides the last word in heating comfort and economy and is available with either hot water or two-pipe steam systems. It permits different sections of the home to be kept at different temperatures. For example, the portion of the home which is used principally for sleeping can be kept at a cooler temperature than the rest of the house. Greater operating economy is obvious, since no fuel is wasted in supplying unnecessary heat.

Zoning a heating system is a simple matter, merely requiring that the piping be divided into as many zones as desired. Little addi-

tional equipment is required. As shown in the diagram at left of a two-zone forced hot water system, the flow of heated water to each zone is controlled by a thermostatically operated Pump and Control Valve.

When heat is needed in any zone, the Thermostat starts the Pump in its respective circuit. The flow of water forces open the Control Valve, permitting heated water to circulate through the zone piping. When the heat requirement is satisfied, the Pump is stopped by the Thermostat and the Control Valve closes, preventing further circulation.

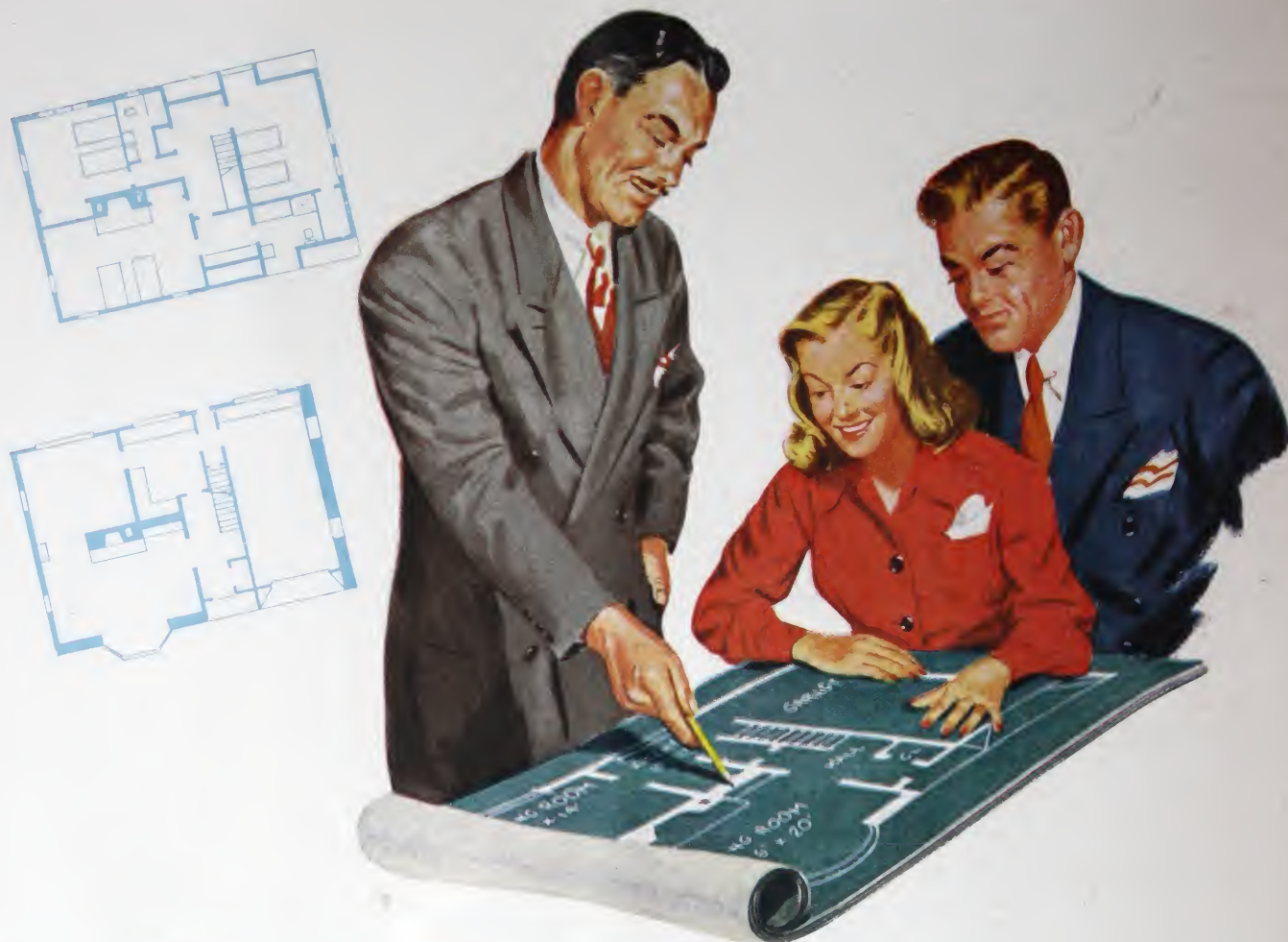


*Typical piping and equipment for a two zone forced hot water system.*



*Room temperature is constant throughout the day, without sharp fluctuations to threaten comfort and health.*





## Do your Planning in advance

**P**LAN your heating system when you plan your house. Don't wait until your house plans are completed before deciding on your heating system. Necessary for the efficient and trouble-free operation of any heating system are: quality materials and equipment; proper installation.

No heating system, no matter how well made and how perfectly designed, can deliver the satisfaction built into it unless it is correctly installed. The knowledge and skill of the heating and piping contractor who assumes the responsibility for the installation is a priceless ingredient in any heating system.

The choice of a heating contractor, therefore, is an important decision. It is wise to choose a man who is known to be qualified by experience to install radiant heating systems and to help you select the type suited to your needs and preferences.

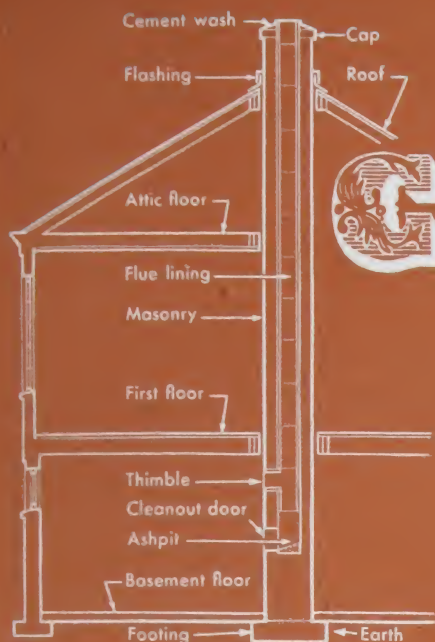
To assist heating and piping contractors in designing heating systems for the utmost efficiency and economy, The Institute of Boiler and Radiator Manufacturers has published a series of I=B=R Installation Guides telling how to design and install hot water and steam heating systems.

These technical data have been made available to architects, engineers, and contractors.

The proper rating of the boiler, that is, its capacity, is of the utmost importance. The adoption of the I=B=R Testing and Rating Code for low pressure heating boilers provided, for the first time, a uniform and scientific method of determining boiler output and establishing dependable net ratings. The I=B=R emblem (see back cover page) on the boiler signifies that it has been tested and rated according to that Code.

Before a manufacturer may adopt and use the I=B=R emblem and I=B=R ratings for any boilers, test data must be submitted to the Boiler Rating Committee of the Institute for approval. This committee consists of a representative body of highly qualified engineers. The purpose of this review is to determine whether the tests have been accurately performed and whether the ratings requested by the manufacturer conform to the requirements of the I=B=R Code.

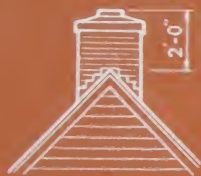
Hot water or steam heating systems, properly installed, will give a lifetime of service with a minimum of attention. When a heating system needs servicing, it is advisable to call an experienced heating and piping contractor.



SECTIONAL VIEW OF CHIMNEY



When chimney is not at peak, it should extend at least 2'-6" above highest point.



Top of chimney should extend at least 2'-0" above peak roof.

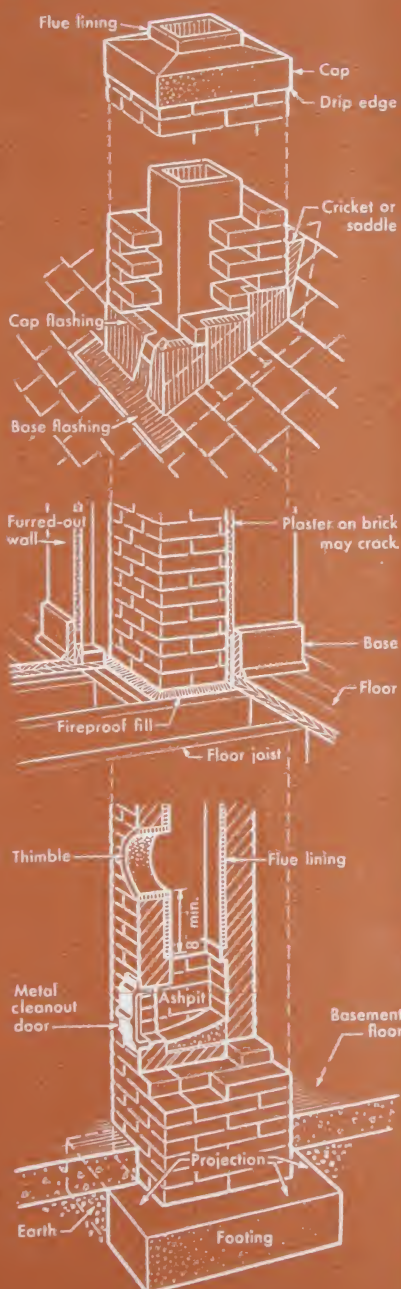


Top of chimney should extend at least 3'-0" above flat roof.

HEIGHT OF CHIMNEY

*Drawings on this page  
by courtesy of  
University of Illinois  
Small Homes Council*

# Chimney and House construction



You may never have thought about the chimney as part of the heating system, yet the efficient operation of the boiler is vitally linked to the proper design, area, height, and construction of the chimney.

The chimney must be capable of producing and maintaining a draft to bring a supply of fresh air to the fire. It must also carry away harmful gases emitted from the fuel-burning equipment. The passage of the chimney through which these gases travel is called a flue. It and the entire chimney must be carefully built in order to be free of fire hazards. Defective or overheated chimneys form the greatest single known cause of residential fires.

A word about chimney location. If your chimney is located on an inside wall, you will reduce construction costs by saving on both material and labor. The efficiency of the chimney will be increased, for if protected from extreme cold it will not cool so rapidly and a better draft will be maintained. The heat of the chimney will also help to warm the rooms through which it passes. In case the chimney must be on an outside wall, it will be more efficient if the masonry of the exposed walls of the chimney is increased 4 inches in thickness (8 inches of masonry and a flue lining) or if insulation is placed between the flue lining and the masonry.

Build your home around a safe and efficient chimney. It is well to remember that a chimney is difficult to remodel. Have it built right in the first place and large enough to handle any type of fuel.

Manufacturers whose boilers have I=B=R ratings are required under the I=B=R Code to publish the dimensions of the chimney which are necessary for efficient performance.

## House Insulation

Insulation is the co-partner of the modern heating system. Insulation increases comfort because it increases the inside surface temperature of the outside walls. This has the effect of decreasing the radiant heat loss from the body.

Higher inside surface temperatures of the outside walls have two additional beneficial effects:

- The temperature of the air near the floor is increased.
- One of the causes of drafts is eliminated.

Insulation, including storm windows and storm doors, always effects substantial economies in fuel consumption. Therefore, when building your home, be sure it is well insulated.

I=B=R Research Home at  
University of Illinois



## I ntensive R esearch

**R**ESearch sparks progress in the radiant heating industry. The research work which manufacturers carry out in their own plants for the improvement of their products is supplemented by a comprehensive and intensive program sponsored by The Institute of Boiler and Radiator Manufacturers at the University of Illinois.

The work is carried on largely in the I=B=R Research Home. This is a typical six-room brick house erected in 1940. It is equipped with every known instrument for the study and measurement of heating comfort. It has been described as the best-equipped house in the world for the scientific investigation of heating systems under actual operating conditions.

Many of the innovations in hot water and steam radiant heating made in recent years are due to the I=B=R Research Program or were thoroughly studied and tested in the I=B=R Research Home. Thus this house is intimately associated with the progress of the heating industry and its efforts to provide the utmost in heating comfort with fuel economy.

The work in the I=B=R Research Home is correlated with other experiments in heating carried on in the laboratories of the Engineering Experiment Station of the University of Illinois. Work being supported by, and carried on in the University of Illinois School of Medicine in Chicago on the physiological aspects of air conditioning is also developing information directly applicable to the field of heating. In the engineering laboratories,

studies are made of the component parts of a heating system. Laboratory equipment includes a cold room and warm wall test booths. Conditions of a below-zero windy wintry day can be simulated and the performance of equipment under all variations of temperature and wind velocity studied.

The objectives of the I=B=R Research Program are to test hot water and steam heating equipment under actual operating conditions in order to determine such characteristics as:

1. Cost of operation. 2. Comfort conditions produced.
3. Methods of control. 4. Air movement and temperatures.
5. Floor to ceiling temperature difference. 6. Temperature differentials between rooms including basement and attic temperatures.
7. Heat loss through the walls. 8. Wall surface temperatures. 9. Domestic hot water from indirect heaters.

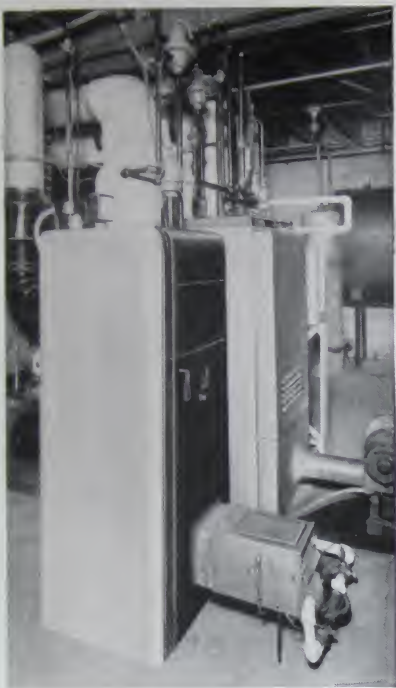
The I=B=R Research Program began with an evaluation of the heat loss of the I=B=R Research Home. Knowing how much heat is generated, and knowing how much heat is lost by the house, the engineers are able to determine how much heat is required for comfort. The next step was the study of the effect of varying radiator locations on heat distribution and comfort.

The third step in the advancing research program was the study of comfort conditions with two methods of controlling a hot water heating system.

These studies scientifically confirmed the



*Look for this Seal on the boiler you buy. It is your assurance that it has been tested and rated in accordance with the I=B=R Testing and Rating Code, thus guaranteeing dependable performance.*



Basement of the I=B=R Research Home. The gas-fired boiler in the foreground was used in the test work during the 1943-1944 heating season. The boiler in the background is the oil-fired boiler originally installed in the Research Home.



Results of the I=B=R Research Program are published in bulletins issued by the University of Illinois and are available on request.



Tests in the I=B=R Research Home resulted in the development of the Radiant Baseboard as a new method of heat distribution.



Shown in the center of the living room of the I=B=R Research Home are four thermocouples on a stand extending from floor to ceiling. These thermocouples are delicate measuring instruments which record the temperature at four different levels. They, along with more than one hundred other thermocouples located in various parts of the house, provide temperature readings at important locations.

## guides progress

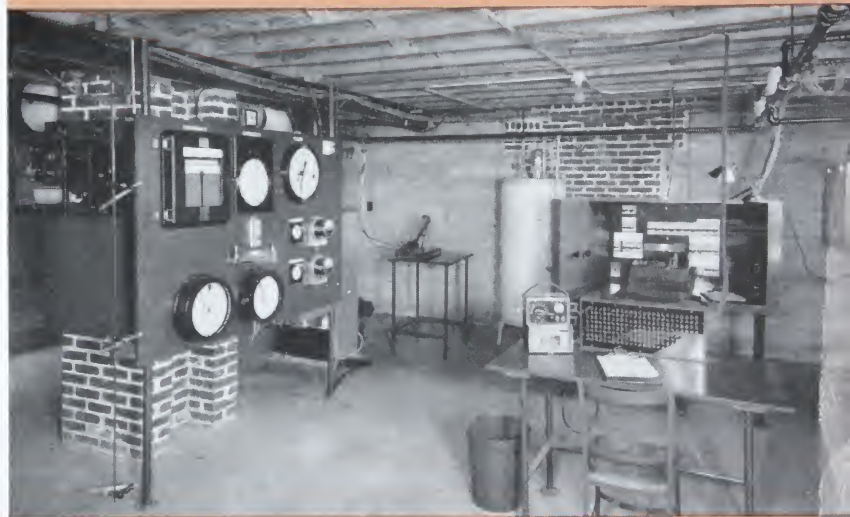
remarkably low cost of providing domestic hot water by the use of an indirect heater attached to the boiler. It was also found that the use of the boiler for heating domestic water during the summer aids in preventing summer dampness in the basement.

Subsequently the Research Program undertook a study of methods of low level heat distribution. These studies resulted in the development by a number of manufacturers of a new unit known as a radiant baseboard. Studies in the I=B=R Research Home have shown a floor to ceiling temperature differential of less than three degrees where radiant baseboards were installed.

Getting the answer to questions about the operation of hot water and steam heating plants is only part of the job. Equally important is the task of putting these answers in the hands of designers, manufacturers, and installers.

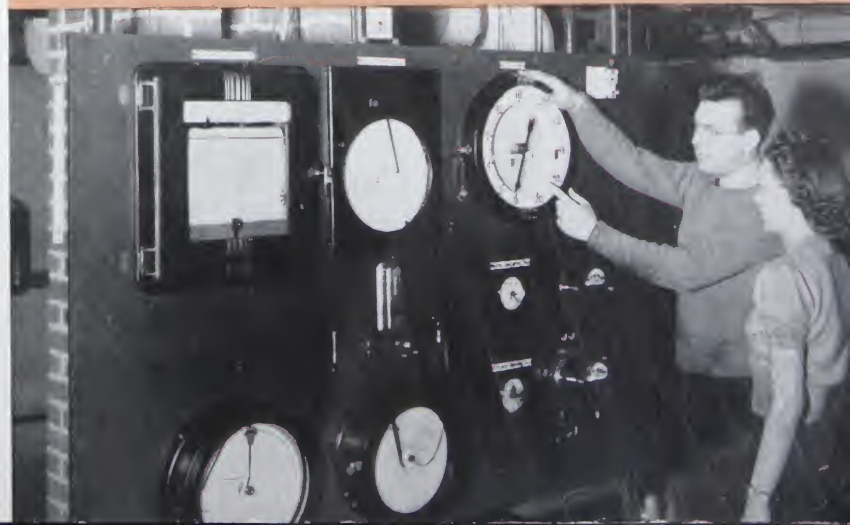
The University of Illinois publishes a series of bulletins in which the findings of the I=B=R Research Program are being made available. The first three of these bulletins entitled "Performance of a Hot Water Heating System in the I=B=R Research Home at the University of Illinois," "A Study of Radiant Baseboard Heating in the I=B=R Research Home," and "Performance of an Indirect Storage Type Hot Water Heater" may now be obtained by writing to the University.

The I=B=R Research Program has also made possible the publication by the Institute of a series of I=B=R Installation Guides for heating contractors, incorporating the latest technical data on installation methods for hot water and steam radiant heating systems and domestic hot water systems.



Center of activity at the I=B=R Research Home is the basement where most of the data are read. Automatic recording instruments are on the panel at the left. Thermocouple readings are made at the larger table while moisture readings are made at the table in the foreground.

Research assistant is explaining how recording potentiometers, flue gas recorders, a CO<sub>2</sub> recorder and the other instruments reveal significant facts about the relationship of all of the factors in a house which make it a more comfortable and healthy place to live.





**THE INSTITUTE OF BOILER AND RADIATOR MANUFACTURERS**  
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